

T07D01 – (7.2.(1-3)) Position of Equilibrium

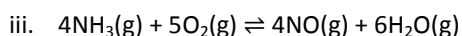
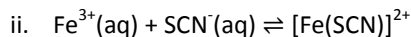
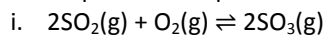
Name

1. 7.2.1 Deduce the equilibrium constant expression (K_c) from the equation for a homogeneous reaction. (3)

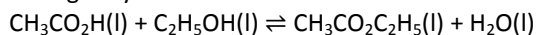
- a. What is the general equation of an equilibrium constant, K_c ? (AKA, the equilibrium law)
- b. For the production of ammonia ($N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$) @500°C, give the expression for K_c during each of the following experiments:

	$[N_2] \text{ mol dm}^{-3}$	$[H_2] \text{ mol dm}^{-3}$	$[NH_3] \text{ mol dm}^{-3}$
Exp. 1	0.992	0.763	0.157
Exp. 2	0.299	1.197	0.203
Exp. 3	2.59	2.77	1.82

- c. Show the equilibrium equation and equilibrium constant expression for both the forward and reverse reactions of the formation of HI(g) from its elements:
- d. What happens to the value of K_c when the reaction is reversed? How is one calculated from the other?
- e. Write the equilibrium expression for the following reactions



- f. The following reaction is an esterification reaction producing ethyl ethanoate:



The value of K_c for this reaction is 4.0 @ 25°C

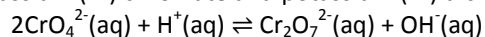
2. 7.2.2 Deduce the extent of a reaction from the magnitude of the equilibrium constant. (3)

- a. How does the magnitude of K_c for the production of hydrogen halides of Cl and I compare? State how the magnitude of K_c sets the equilibrium in general:
- b. What are the relative values of K_c ?

$K_c < 10^{-10}$	$K_c = 0.01$	$K_c = 1$	$K_c = 100$	$K_c > 10^{10}$

- c. What is K_c NOT altered by?

- d. For the equilibrium between potassium (IV) chromate and potassium (IV) dichromate the equation is



state the equilibrium expression and explain how we can study this reaction:

3. 7.2.3 Apply Le Chatelier's principle to predict the qualitative effects of changes of temperature, pressure and concentration on the position of equilibrium and on the value of the equilibrium constant. (2)

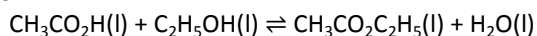
- a. State Le Chatelier's Principle (you do not need to memorize this):

- b. What does this principle really mean?

- c. What are the effects on the position of equilibrium and the value of K_c when the following changes in environment take place?

Change Made	Effect on position of equilibrium	Value of K_c
[conc] is changed		
Pressure		
Temperature		
Catalyst		

- d. For the esterification reaction of



Explain what happens when water is removed to the reaction at equilibrium:

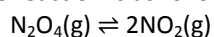
- e. The production of Ammonia is very important, what happens when the concentration of N_2 is changed?

Equilibrium Reaction	When Excess N_2 is added

- f. In general, what happens when the [reactant] or [product] is increased?

- g. Explain how Le Chatelier's principle accounts for a change in pressure (due to volume change):

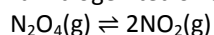
- h. When dinitrogen tetroxide is decomposed the reaction is as follows:



Explain what happens when a change in pressure occurs and how it can be monitored:

- i. What happens to equilibrium when the temperature is changed, and why?

- j. For the same reaction of the decomposition of dinitrogen tetroxide:



How does the change in temperature effect the equilibrium, and how can it be monitored:

- k. The effect of temperature on the equilibrium is dependent on the enthalpy of reaction, complete the following table to show the relative changes:

Nature of forward reaction	Change in Temperature	Shift in the position of equilibrium	Effect on value of K_c

Next class:

- 7.2.4 State and explain the effect of a catalyst on an equilibrium reaction. (3)
- 7.2.5 Apply the concepts of kinetics and equilibrium to industrial processes. (2)